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# Systematic review of prognostic cohort studies on shoulder disorders

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**Abstract**

Shoulder complaints are common and have an unfavourable outcome in many patients. Only 50% of all new episodes of shoulder disorders end in complete recovery within 6 months. There is no consensus about prognostic indicators that can identify patients at high and low risk of chronicity. By a systematic search of the literature we identified 16 studies focusing on the prognosis of shoulder disorders. The methodological quality of these 16 studies was assessed. Six of these were considered to be of relatively 'high quality'. There was a wide variety among the studies in length of follow-up, study population, evaluated prognostic factors, type of outcome measure and method of analysis. Due to this large heterogeneity, we refrained from statistical pooling. Instead, we used a best-evidence synthesis. There is strong evidence that high pain intensity predicts a poorer outcome in primary care populations and that middle age (45–54) is associated with poor outcome in occupational populations. There is moderate evidence that a long duration of complaints, and high disability score at baseline predict a poorer outcome in primary care. These results need to be interpreted with caution because of the small number of studies on which these conclusions are based, and the large heterogeneity among studies regarding follow-up, outcome measures, and analysis.


*Keywords:* Musculoskeletal disorders; Shoulder; Prognosis; Systematic review

## 1. Introduction

Shoulder disorders are common. The 1 year prevalence in various studies ranges between 5 and 47% (Luime et al., 2003; Van der Heijden, 1999). The point prevalence in the general population in The Netherlands has recently been estimated at 21% (Picavet and Schouten, 2003). In a British study a lower point prevalence of 14% has been found (Bongers, 2001). The annual incidence of shoulder disorders in Dutch general practice ranges between 12 and 25/1000 per year (Van der Windt et al., 1995; Okkes et al., 1998).

Shoulder complaints have an unfavourable outcome in many patients. Only about 50% of all new episodes of shoulder complaints presented in primary care show complete recovery within 6 months (Croft et al., 1996; Van der Windt et al., 1996; Winters et al., 1997), after 1 year this proportion increases to only 60% (Van der Windt et al., 1996).

Van der Heijden (1999) reviewed the literature on prognostic indicators of a favourable outcome within 3 months, in a narrative way. Evidence for all reported factors was weak, and most studies appeared to be of relatively poor methodological quality. Little is known about the prognostic value of psychosocial factors. It is suggested that psychosocial factors such as inadequate pain cognitions and pain behaviour, are likely to predict a poor outcome of painful musculoskeletal conditions (Van der Heijden, 1999).

It is of importance for clinical practice to know more about the prognostic value of clinical, psychosocial, and occupational factors in patients with shoulder disorders. It may help to provide patients with adequate information regarding the most likely course of their symptoms. Health care providers need prognostic information to distinguish between patients with a favourable outcome and those with a high risk of chronic shoulder pain and disability. This may facilitate decisions regarding treatment and referral of patients. However, no attempts have been made to conduct a systematic search of the literature and to summarise

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the available evidence regarding prognostic factors of shoulder disorders.

## 2. Methods

### 2.1. Identification and selection of the literature

We conducted a systematic, computerised search of the literature based on recommendations by Haynes et al. (1994) in Medline (1966 to February 2003), Embase (1991 to February 2003), Cinahl (1982 to February 2003), Psychinfo (1967 to February 2003), Sportdiscus (1949 to February 2003). The following key words and medical subject headings were used: shoulder, shoulder pain, shoulder joint, shoulder injuries, shoulder impingement syndrome, prognos*(truncated), predict*(truncated), course, clinical study, longitudinal study, prospective study and retrospective study. The citations we found were screened by two reviewers independently (TK and DW). The reference lists of all selected publications were checked to retrieve relevant publications which had not been found with the computerised search. The publications had to meet the following selection criteria:

- the study focussed on patients suffering from shoulder complaints
- the association (ORs or RRs, with corresponding p-value or 95% CI) of at least one prognostic factor with the outcome of shoulder pain had to be presented
- the design had to be a cohort study
- the article was published in English
- results were published as a full report before February 2003
- studies that focussed on shoulder pain due to luxation, cancer or systemic diseases such as rheumatoid arthritis or osteoporosis were excluded. Also studies that focussed on the results of surgery were excluded.

### 2.2. Quality assessment

The methodological quality of each of the studies was assessed independently by three reviewers (TK, DW and GH). A standardised checklist of predefined criteria was used, which is a modified version of the checklists by Borghouts et al. (1998), Hudak et al. (1998) and Scholten-Peeters et al. (2003), and is based on theoretical considerations and methodological aspects described by Altman (2001) and Hudak et al. (1998) (Table 1). Disagreements among the reviewers were discussed during a consensus meeting. In case of persisting disagreement between 2 reviewers it was the third that made the final decision. The checklist covers aspects of internal validity (criteria A, D, E, F, G, H, I, J, K, L, M, P, Q), generalisability (criteria B, C, N, O) and precision (criterion R), which are all of great importance in descriptive epidemiological studies (Altman, 2001). The list contains 7 categories: study population, response rate, follow-up, treatment, outcome, prognostic factors and data presentation. The list contains 18 criteria which can be scored positive (‘ + ’), negative (‘ − ’) or ‘unclear (‘?’). A positive score indicates sufficient information and a positive assessment. A negative score indicates sufficient information, but potential bias due to inadequate design or conduct. A negative score can only be assigned to criteria of internal validity. If an item is scored as ‘unclear’ it means that the paper provides insufficient information about this criterion. Exceptions are criteria N, O and R, because an ‘unclear’ did not make sense here. A more detailed explanation of each criterion is given in Appendix A.

The maximum attainable score on the criteria list is 18 points. The total score is the sum of all the criteria which are scored positive, negative scores are not subtracted. A priori, we chose to consider a study of ‘high quality’ when it scores more than 10 points ($>60\%$ of the maximum attainable score) and of ‘low quality’ when it scores $\leq 10$ points. Sensitivity analyses were conducted to assess the robustness of this cut-off point, that is, whether this change will lead to different conclusions.

### 2.3. Data extraction

Data were extracted of the selected studies regarding study population, design, setting, outcome measures, prognostic factors and strength of association. To facilitate interpretation and comparison of the results the studies are categorised per setting (primary care, secondary care and occupational setting). When not given, and sufficient data were available, for each study the univariate association was calculated between prognostic factors and outcome in terms of Risks Ratios (RR) or Odds Ratios (OR) with 95% confidence intervals (CI). Univariate, or if available multivariate associations were presented in tables.

### 2.4. Analysis

Depending on homogeneity in study population, type of prognostic factors, outcome measures, and study quality, statistical pooling was considered. When a pooled estimate could not be computed, a qualitative analysis (best evidence synthesis) was performed to summarize the value of the prognostic indicators. In this analysis the available evidence for a prognostic factor was summarised by taking into account the number of studies evaluating this factor, the methodological quality of these studies, and the consistency of the available evidence. We present prognostic factors which showed in at least one study a RR or OR above 2.0 or below 0.5 or a statistically significant ($P < 0.05$) association. We did not want to depend solely on statistical significance, as many cohorts included in the review were rather small, and relevant associations between prognostic factors and outcomes may have remained undetected.

Table 1
Criteria list for assessing the methodological quality of prognostic cohort studies on shoulder disorders

| Criteria | | Score |
|---|---|---|
| *Study population* | | |
| A. | Inception cohort (defined in relationship to onset of symptoms) | +/−/? |
| B. | Description of inclusion and exclusion criteria | +/? |
| C. | Description of studypopulation | +/? |
| *Response* | | |
| D. | Response ≥75% | +/−/? |
| E. | Information about non-responders versus responders | +/−/? |
| *Follow-up (extent and length)* | | |
| F. | Prospective data collection | +/−/? |
| G. | Follow-up of at least 6 months | +/−/? |
| H. | Drop-outs/loss to follow-up <20% | +/−/? |
| I. | Information completers versus loss to follow-up/drop-outs | +/−/? |
| *Treatment* | | |
| J. | Treatment in cohort is fully described/standardised | +/−/? |
| *Outcome* | | |
| K. | Standardised assessment of relevant outcome criteria | +/? |
| *Prognostic factors* | | |
| L. | Standardised assessment of patient characteristics and potential clinical prognostic factor(s) | +/? |
| M. | Standardised assessment of potential psychosocial prognostic factor(s) | +/? |
| *Data presentation* | | |
| N. | Frequencies of most important outcome measures | +/− |
| O. | Frequencies of most important prognostic factors | +/− |
| P. | Appropriate analysis techniques | +/−/? |
| Q. | Prognostic model is presented | +/−/? |
| R. | Sufficient numbers | +/− |

+, Positive (sufficient information and a positive assessment); −, negative (sufficient information, but potential bias due to inadequate design or conduct); ?, unclear (insufficient information).

Findings were considered consistent if ≥75% of the studies which reported a factor showed the same direction of the association. In Table 2 we defined four levels of evidence which are based on Sackett et al. (2000) and Ariëns et al. (2000) (Table 2).

Table 2
Levels of evidence for prognostic factors on shoulder disorders

| Level of evidence | |
|---|---|
| Strong | Consistent findings (≥75%) in at least 2 high quality cohorts |
| Moderate | Consistent findings (≥75%) in one high quality cohort and at least one low quality cohort |
| Weak | Findings of one high quality cohort or consistent findings (≥75%) in at least 3 or more low quality cohorts |
| Inconclusive | Inconsistent findings irrespective of study quality, or less than 3 low quality cohorts available |
| No evidence | No data presented |

## 3. Results

### 3.1. Selection of studies

We found 1273 citations (468 Pubmed, 507 Embase, 211 Cinahl, 54 Psychinfo, 33 Sportdiscus). Out of this number 48 abstracts seemed to fulfil the selection criteria and the full publications of these were retrieved. When assessing the full publications some turned out to focus on rotator cuff tears ($n = 2$), some papers aimed at etiology instead of prognosis ($n = 4$), some dealt with treatment ($n = 7$), and some with diagnoses ($n = 1$). Not presenting a separate analysis for shoulder disorders ($n = 18$) was a major reason for excluding papers. Finally, 16 papers were included and the methodological score was assessed.

### 3.2. Methodological quality

The results of the quality assessment are presented in Table 3. The overall quality score ranged from 4 to 15 points, with a median score of 10 points. Using our cut-off point of >10 points, 6 studies were classified as high quality studies. The items of the criteria list which most often (>8 of the 16 publications) obtained a negative score were 'Inception cohort' (item A), 'Adequate response rate' (item D), 'Information about responder/non-responders' (item E), 'Follow-up >6 months' (item H), 'Adequate information about loss to follow-up' (item I), 'Treatment described/standardised' (item J), 'Assessment of psychosocial factors' (item M) and 'Prognostic model presented' (item Q). Only 2 studies (Miranda et al., 2001; Viikari-Juntura et al., 2000) presented information about response-rate and information about characteristics of responders versus non-responders in order to evaluate whether the response was selective or not. Only 5 studies (Bartolozzi et al., 1994; Binder et al., 1984; Brox and Brevik, 1996; Morrison et al., 1997; Mulcahy et al., 1994) presented information regarding treatment and whether it was standardised. Seven studies (Brox and Brevik, 1996; Cassou et al., 2002; Macfarlane et al., 1998; Miranda et al., 2001; Van der Windt et al., 1996; Viikari-Juntura et al., 2000; Solomon et al., 2001) used adequate methods to compose a multivariable prognostic model. The studies (Kaergaard and Andersen, 2000; Kuroda et al., 2001; Shaffer et al., 1992; Mulcahy et al., 1994) with a method score in the lowest tertile of the scale (≤33%) all suffered from inadequate data presentation (item N, O, P, Q, R).

Table 3
Results of the methodological assessment of prognostic cohort studies on shoulder disorders

| First author | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | Quality score (total '+') | Score (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cassou et al. (2002) | + | + | + | + | ? | + | + | + | ? | ? | + | + | + | + | + | + | + | + | 15 | 83 |
| Brox and Brevik (1996) | − | + | + | − | ? | + | + | + | ? | + | + | + | + | + | + | + | + | + | 14 | 78 |
| Van der Windt et al. (1996) | + | + | + | + | − | + | + | + | − | − | + | + | ? | + | + | + | + | + | 14 | 78 |
| Macfarlane et al. (1998) | − | ? | + | + | ? | + | + | − | + | ? | + | + | + | + | + | + | + | + | 13 | 72 |
| Miranda et al. (2001) | ? | ? | + | + | + | + | + | ? | ? | ? | + | + | + | + | − | + | + | + | 12 | 67 |
| Chard et al. (1988) | + | ? | + | ? | ? | + | + | + | ? | ? | + | + | ? | + | + | + | ? | + | 11 | 61 |
| Morrison et al. (1997) | ? | + | − | ? | ? | + | + | + | ? | + | + | + | ? | + | + | − | − | + | 10 | 56 |
| Bartolozzi et al. (1994) | − | + | − | ? | ? | + | + | − | ? | + | + | + | ? | + | + | + | − | + | 10 | 56 |
| Viikari-Juntura et al. (2000) | + | ? | + | − | + | + | − | ? | ? | ? | + | ? | ? | + | + | + | + | + | 10 | 56 |
| Binder et al. (1984) | − | + | − | ? | ? | + | + | + | ? | + | + | + | ? | + | + | − | − | − | 9 | 50 |
| Solomon et al. (2001) | − | + | + | ? | ? | + | + | ? | ? | ? | + | + | ? | − | + | + | + | − | 9 | 50 |
| Croft et al. (1996) | + | ? | + | ? | ? | + | + | − | + | ? | + | ? | ? | + | − | + | ? | + | 9 | 50 |
| Shaffer et al. (1992) | − | + | + | ? | ? | + | + | − | ? | − | + | ? | ? | + | − | − | − | − | 6 | 33 |
| Kaergaard and Andersen (2000) | ? | ? | + | + | ? | + | + | − | − | ? | + | ? | + | − | − | ? | ? | − | 6 | 33 |
| Kuroda et al. (2001) | ? | ? | + | ? | ? | + | + | ? | ? | ? | ? | ? | ? | + | − | ? | ? | + | 5 | 28 |
| Mulcahy et al. (1994) | − | ? | + | ? | ? | + | − | − | ? | + | + | ? | ? | ? | − | − | − | − | 4 | 22 |

### 3.3. Study characteristics

Table 4 summarises the study characteristics of the publications including study population, outcome measures, follow-up, prognostic factors and the strength of the association with their 95% confidence interval. Four studies were conducted in a primary care setting, another 4 in an occupational setting and 8 in a hospital setting. Most frequently reported prognostic factors were pain, duration of complaints, age and gender. A few studies (Brox and Brevik, 1996; Cassou et al., 2002; Miranda et al., 2001) assessed the value of psychosocial predictors. There was considerable variation among the studies with respect to the length of follow-up (range 2 months to 7 years), type of outcome measure (pain, disability, recovery, sick leave, ROM, different shoulder questionnaires) and method of analysis (univariate vs. multivariate). Hence, we considered statistical pooling to be not sensible, and therefore used a best-evidence synthesis to summarize the importance of prognostic factors (Table 2).

### 3.4. Levels of evidence

In Table 5 we only present those prognostic factors which in at least 1 study showed RR or OR above 2.0 or below 0.5 or a statistically significant ($P < 0.05$) association. Most factors were only measured in one study, and consequently their prognostic value remains uncertain. There is, however, strong evidence that high pain intensity predicts a poorer outcome (Macfarlane et al., 1998; Van der Windt et al., 1996) in primary care populations and that middle age (45–54) (Cassou et al., 2002; Miranda et al., 2001) is associated with poor outcome in occupational populations (Table 5). In addition, there is moderate evidence that a long duration of complaints, and high disability score at baseline predict a poorer outcome in primary care (Table 5). Factors with RR or OR between 0.5 and 2.0 or a not statistically significant association were, for example, years of education, repetitive work, precipitating trauma and instability of the glenohumeral joint (Table 4).

### 3.5. Psychosocial factors

There are a few studies (Bjorksten and Talback, 2001; Brox and Brevik, 1996; Cassou et al., 2002; Kaergaard and Andersen, 2000; Miranda et al., 2001) which considered psychosocial factors (locus of control, emotional distress, job demand, job control, mental stress). None of these studies showed RR or OR above 2.0 or below 0.5 or a statistically significant ($P < 0.05$) association.

## 4. Discussion

The present paper is the first systematic review of the current literature on potential prognostic indicators of shoulder disorders. Van der Heijden (1999) conducted a narrative review of the literature, and found the following prognostic indicators of a favourable outcome within 3 months: mild trauma preceding symptoms, early presentation, preceding overuse and heavy and unusual activities of the upper extremity, an acute onset, a high erythrocyte sedimentation rate, and restricted prescription and use of medication. Factors that were reported to predict a poor outcome at 3 months were severe pain at first presentation, a prior episode, a severe restriction of the passive abduction range, diabetes mellitus, concomitant neck pain, cervical spondylosis and radicular symptoms, higher age,

Table 4
Summary of study characteristics of prognostic cohort studies on shoulder disorders

| First Author | Study quality (%) | Study population | Outcome measures/duration follow-up | Prognostic factor (s) | Strength of association (95% CI) | |
|---|---|---|---|---|---|---|
| *Primary care/population-based cohorts* | | | | | | |
| Brox and Brevik (1996) | 78 | Patients with diagnosis of rotator tendinosis, referred by general practitioners | Neer shoulder score (0–100) | | Multivariate analysis, adjusted for age, gender, symptom duration, baseline Neer score: | |
| | | $N = 125$ (participants of a RCT comparing surgery, exercises, and placebo laser), drop-out 9% | Succes: ≥ 80 points (6 months) | Not on sick leave | OR = 4.4 (1.6–12.1) | |
| | | | | Not on regular medication | OR = 4.2 (1.5–11.1) | |
| | | | | Active treatment (ref = not active) | OR = 4.8 (1.7–13.6) | |
| | | | | Years of education, overhead work activity, comorbidity, isometric strength endurance, locus of control beliefs, emotional distress | n.s. | |
| Van der Windt et al. (1996) | 78 | Patients with a new episode of shoulder pain (not consulted their GP in the preceding year). $N = 349$, drop-out 13% | Persistent symptoms (12 months) | | Multivariate analysis: | |
| | | | | Concomitant neck pain | OR = 2.8 (1.7–4.6) | |
| | | | | High pain intensity | OR = 2.0 (1.2–3.3) | |
| | | | | Precipitating trauma | OR = 0.4 (0.2–0.9) | |
| | | | | Diagnosis (acute bursitis) | OR = 0.4 (0.2–0.8) | |
| | | | | Age, gender, arm dominance, | n.s. | |
| Macfarlane et al. (1998) | 72 | Shoulder pain (current or in the preceding month): self-report questionnaire $N = 135$, drop-out 18% | % Shoulder pain (3 years) | | Multivariate analysis, adjusted for age and sex: | |
| | | | | Pain at baseline | OR = 3.1 (1.1–8.2) | |
| | | | | Symptom duration (>1 year) | OR = 2.9 (1.1–7.7) | |
| | | | | Shoulder related disability (≥5 items on 22–item questionnaire) | OR = 3.1 (0.9–11.0) | |
| | | | | Age, sex, GP visit, area of pain, sudden onset, distress (GHQ), restricted ROM | n.s. | |
| Croft et al. (1996) | 50 | Patients with a new episode of shoulder pain in general practice $N = 166$, drop-out 25% | Validated 22-item disability questionnaire (6 months) | Baseline disability score > 10, Symptom duration (>1 month), Injection at baseline, Previous episodes of shoulder pain, Severely restricted passive elevation (<101°). | Poorer outcome ($P < 0.05$) (Beta's not presented) | |
| *Occupational medicine* | | | | | | |
| Cassou et al. (2002) | 83 | Workers born in 1938, 1943, 1948 and 1953 with chronic neck-shoulder pain (>6 months), random sample from occupational physicians' files. $N = 1804$ (in final analysis), drop-out 12.6% | % Disappearance of pain (5 years) | | Multivariate analysis: Men | Women |
| | | | | Year of birth (ref = 1953) | | |
| | | | | 1948 | OR = 1.5 (0.9–2.5) | OR = 0.8 (0.5–1.2) |
| | | | | 1945 | OR = 1.2 (0.8–1.9) | OR = 0.6 (0.4–0.8) |
| | | | | 1938 | OR = 1.0 (0.6–1.5) | OR = 0.6 (0.4–0.9) |
| | | | | Repetitive work (ref = never) | | |
| | | | | In 1990 | Univariate only | 0.8 (0.5–1.3) |
| | | | | Before 1990 | Univariate only | 0.5 (0.3–0.7) |
| | | | | High job demand | OR = 0.7 (0.5–0.9) | 0.7 (0.6–0.9) |
| | | | | Previous musculoskeletal disorders | OR = 0.4 (0.3–0.6) | 0.6 (0.5–0.8) |
| | | | | Sporting activities | OR = 1.5 (1.1–2.1) | Univariate only |
| | | | | Precise movements, awkward work, repetitive work, job control, shift work | n.s. | n.s. |

(*continued on next page*)

Table 4 (*continued*)

| First Author | Study quality (%) | Study population | Outcome measures/duration follow-up | Prognostic factor (s) | Strength of association (95% CI) |
|---|---|---|---|---|---|
| Miranda et al. (2001) | 67 | Employees of a forestry company in Finland reporting severe shoulder pain: >30 days in the preceding 12 months. $N = 419$ | % Persistent severe pain (12 months) | Individual factors: | Multivariate OR |
| | | | | Age | |
| | | | | < 35 | OR = 1.0 |
| | | | | 35–44 | OR = 0.9 (0.3–2.6) |
| | | | | 45–54 | OR = 3.6 (1.3–10.2) |
| | | | | ≥ 55 | OR = 1.6 (0.5–4.8) |
| | | | | Sports activity added score | |
| | | | | > 156 vs <52 | OR = 0.7 (0.4–1.3) |
| | | | | Gender (female) | OR = 0.7 (0.4–1.2) |
| | | | | Overload at work (definite vs none) | OR = 3.8 (1.8–8.0) |
| | | | | Other work load factors (e.g. working above shoulder level), mental stress, body mass index | n.s. |
| Viikari-Juntura et al., 2000 | 56 | Patients seeking medical advice for a new episode of neck-shoulder pain at an occupational health service. $N = 474$ | Sick leave >3 days (60 days) | | Multivariate analysis: |
| | | | | Worker group (blue collar) | OR = 6.8 (2.1–22.4) |
| | | | | Sick leave preceding examination | OR = 6.5 (2.1–20.4) |
| | | | | Symptom duration >7 days vs. 0–2 days | OR = 0.1 (0.0–0.3) |
| | | | | Continuous pain | OR = 1.7 (0.5–5.7) |
| | | | | High pain intensity | OR = 1.1 (0.3–4.0) |
| | | | | Interaction continuous pain x intensity | OR = 5.2 (1.0–28.1) |
| | | | | Pain during rotation of the head | OR = 7.8 (3.0–20.1) |
| | | | | Pain in shoulder in abduction of arm | OR = 5.9 (2.7–12.7) |
| | | | | Other symptoms and signs | n.s. |
| Kaergaard and Andersen (2000) | 33 | Female sewing machine operators with neck-shoulder disorders. $N = 40$, drop-out 30% | % Recovery (2 years) | Work exposure | n.s. |
| | | | | Physical activity at leisure time | n.s. |
| Chard et al. (1988) | 61 | Patients with rotator cuff tendinitis ≥ 6 months after their first attendance in a shoulder clinic. $N = 137$, drop-out 6%. | Shoulder pain resolved (mean 19 months) | Precipitating Cause | Univariate analysis: |
| | | | | Unknown | RR = 1.0 |
| | | | | Injury | RR = 0.76 (0.4–1.42) |
| | | | | Employment | RR = 0.63 (0.29–1.4) |
| | | | | Overuse/strain | RR = 1.30 (0.82–2.06) |
| | | | | Occupation | |
| | | | | Housewife/retired | RR = 1.0 |
| | | | | Manual | RR = 0.88 (0.52–1.51) |
| | | | | Non-manual | RR = 1.09 (0.67–1.76) |
| *Secondary care* | | | | | |
| Morrison et al. (1997) | 56 | Patients diagnosed with subacromial impingement syndrome at center for sports medicine (historic cohort study). $N = 667$, drop-out 8%. | Shoulder rating system University of California Los Angeles (≥28 points). (mean 27 months follow-up) | | Univariate analysis: |
| | | | | Female | RR = 0.97 (0.86–1.09) |
| | | | | Dominance | |
| | | | | Dominant | RR = 1.0 |
| | | | | Non-dominant | RR = 0.92 (0.81–1.05) |
| | | | | Bilateral | RR = 0.87 (0.67–1.13) |
| | | | | Type Acromion | |
| | | | | Type I | RR = 1.0 |
| | | | | Type II | RR = 0.74 (0.65–0.84) |
| | | | | Type III | RR = 0.7 (0.61–0.8) |
| | | | | Tenderness acromioclavicular joint | |
| | | | | Yes/no | RR = 0.83 (0.7–0.98) |

(*continued on next page*)

Table 4 (*continued*)

| First Author | Study quality (%) | Study population | Outcome measures/duration follow-up | Prognostic factor (s) | Strength of association (95% CI) | |
|---|---|---|---|---|---|---|
| | | | | Age | | |
| | | | | < 20 | RR = 1.0 | |
| | | | | 21–40 | RR = 0.88 (0.7–1.11) | |
| | | | | 41–60 | RR = 1.00 (0.8–1.25) | |
| | | | | > 60 | RR = 0.76 (0.57–1.01) | |
| | | | | Onset | | |
| | | | | Acute | RR = 1.0 | |
| | | | | Non-acute | RR = 0.81 (0.7–0.94) | |
| | | | | Chronic | RR = 0.86 (0.75–0.99) | |
| Bartolozzi et al., 1994 | 56 | Patients attending orthopaedic department with impingement syndrome treated non-operatively. $N = 170$, drop-out = 20%. | Shoulder rating system University of California Los Angeles (≥29 points) (mean 20 months, > 6 months) | | Univariate analysis: | |
| | | | | Female | $RR_{female/male} = 1.03$ (0.81–1.31) | |
| | | | | Age | $RR_{40-60/<40y} = 1.10$ (0.78–1.56) | |
| | | | | | $RR_{>60/<40y} = 1.23$ (0.89–1.71) | |
| | | | | Dominance | $RR_{non\text{-}dominant/dom} = 0.95$ (0.74–1.24) | |
| | | | | Onset of symptoms | $RR_{insidious/acute} = 0.97$ (0.75–1.26) | |
| | | | | Duration of pre-treatment symptoms* | $RR_{3-6\ mnths/<3\ mnths} = 0.90$ (0.72–1.14) | |
| | | | | | $RR_{>6\ mnths/<3\ mnths} = 0.69$ (0.52–0.91) | |
| | | | | Functional impairment* | $RR_{moderate/mild} = 0.81$ (0.60–1.09) | |
| | | | | | $RR_{severe/mild} = 0.65$ (0.46–0.91) | |
| | | | | Recreational or occupational demands | $RR_{moderate/low} = 1.18$ (0.85–1.64) | |
| | | | | | $RR_{severe/low} = 1.25$ (0.97–1.62) | |
| | | | | Instability | $RR_{present/absent} = 0.97$ (0.64–1.46) | |
| | | | | ROM | $RR_{mild/none} = 0.85$ (0.60–1.20) | |
| | | | | | $RR_{moderate/none} = 0.78$ (0.45–1.36) | |
| | | | | | $RR_{severe/none} = 0.96$ (0.63–1.46) | |
| | | | | Weakness | $RR_{yes/no} = 0.68$ (0.49–0.93) | |
| | | | | Rotator cuff pathology* | | |
| | | | | Impingement or tendinitis | RR = 1.0 | |
| | | | | Partial or small full thickness tear | RR = 0.82 (0.53–1.26) | |
| | | | | Moderate or large tear | RR = 0.34 (0.14–0.80) | |
| | | | | Treatment | No significant differences | |
| Binder et al. (1984) | 50 | Patients attending a rheumatology department with shoulder pain for >1 month (diagnosis frozen shoulder). Participants in a RCT. $N = 42$, drop-out 5% | ROM (mean 44 months) | | mean difference abduction | |
| | | | | Non-dominant side involved | Better: 12° ($P < 0.05$) | |
| | | | | Manual work | Worse: 15° ($P < 0.05$) | |
| | | | | Therapy: mobilisation versus injections, ice, or no additional treatment | Worse: 15° ($P < 0.05$) | |
| | | | | Age, sex, symptom duration | n.s. | |
| Solomon et al. (2001) | 50 | Consecutive patients presenting acute shoulder pain to general internists, rheumatologists, or orthopaedic surgeons. $N = 63$ | Pain and function: Shoulder Pain and Disability Index (12 months) | Multivariate associations: | Improvement pain | Improvement function |
| | | | | Referred | $\beta = -2.4$, $P = 0.02$ | $\beta = -1.4$, $P = 0.17$ |
| | | | | Worse baseline pain, per point | $\beta = -4.2$, $P = 0.0002$ | Not in the model |
| | | | | Worse baseline function per point | Not in the model | $\beta = -4.9$, $P$=0.0001 |
| | | | | Older age per year | $\beta = 1.2$, $P = 0.24$ | $\beta = -0.8$, $P = 0.46$ |
| | | | | Female | $\beta = 1.4$, $P = 0.2$ | $\beta = 1.3$, $P = 0.20$ |
| | | | | More education, per year | $\beta = 3.3$, $P = 0.0019$ | $\beta = 2.1$, $P = 0.047$ |
| | | | | Longer pain duration per month | $\beta = -2.2$, $P = 0.038$ | $\beta = -1.2$, $P = 0.24$ |
| | | | | Osteoarthritis | $\beta = 2.3$, $P = 0.026$ | $\beta = 1.0$, $P = 0.34$ |
| | | | | Rotator cuff tear | $\beta = -1.4$, $P = 0.026$ | $\beta = 1.1$, $P = 0.26$ |

(*continued on next page*)

Table 4 (*continued*)

| First Author | Study quality (%) | Study population | Outcome measures/duration follow-up | Prognostic factor (s) | Strength of association (95% CI) |
|---|---|---|---|---|---|
| Shaffer et al. (1992) | 33 | Patients with a diagnosis of either adhesive capsulitis or frozen shoulder in an orthopaedic clinic (retrospective study). $N = 92$, drop out 33% | ROM (mean 7 years) | Age,<br>Dominance,<br>Side,<br>Acute or gradual onset,<br>Minor trauma or spontaneous onset,<br>Duration of symptoms at baseline,<br>Treatment,<br>Response to treatment,<br>Bilateral involvement,<br>Associated medical problems. | n.s. |
| Kuroda et al., 2001 | 28 | Patients who visited a Shoulder Disorder Clinic (Hospital) with atraumatic shoulder instability.<br>$N = 341$ | Recovery ($\geq 3$ years) | Stopping overhead sports<br>Stopping non-overhead sports<br><br>Female<br>Age | RR for recovery:<br>RR = 8.67 (2.7–27.1)<br>RR = 1.37 (0.55–3.43)<br><br>RR = 0.94 (0.56–1.58)<br>$P = 0.01$ |
| Mulcahy et al., 1994 | 22 | Patients with frozen shoulder, referred for arthrographic examination<br>$N = 51$, drop-out 25% | Better, unchanged, worse ($<6$ months) | Tears (vs. no tears) | RR = 0.77 (0.47–1.28) |

RR, relative risk; OR, odds ratio; CI confidence interval; ROM, range of motion; n.s., not significant. *Independent predictors in a multivariate analysis (no frequencies).

involvement of the dominant side and sick-leave from work. Evidence for each of these factors was weak, and most studies appeared to be of relatively poor methodological quality.

In our systematic review we found disappointingly little evidence for most factors which in current literature are suggested to be of prognostic importance. Caution is needed with the interpretation of the results of our analysis, because the majority of studies suffer from many flaws in the design and conduct. Yet, there is consistent evidence that high pain intensity in primary care populations and middle age (45–54) in occupational populations are strong predictors for a poor prognosis, while there is some evidence that long duration of complaints and high disability score at baseline are predictors for a poor prognosis in primary care populations. There were no studies of sufficient quality of methods in secondary care. To date, there is no evidence for the prognostic importance of psychosocial factors.

Only 16 studies met our inclusion criteria, of which 6 were of high quality of methods. Besides the overall lack of quality of methods there was considerable heterogeneity regarding design, study populations, prognostic factors and outcome measures. This heterogeneity impedes meta-analysis. Therefore we decided to perform a best evidence synthesis of the available evidence.

### 4.1. Limitations

We restricted our search to full papers published in English. However, the influence of language bias is disputed, and its effect has not been firmly established (Egger et al., 1997; Moher et al., 1996, 2000). We searched in electronic databases that are considered to be important and relevant for the topic of our review. Yet, we may have missed studies which are not included in these databases and which were not identified during our additional reference checking, for instance non-journal publications or unpublished cohort studies. The addition of non-journal publications has been shown to move the effect estimates towards a null result (Burdett et al., 2003; Easterbrook et al., 1991). Given the fact that our review could not demonstrate strong evidence for many relevant prognostic factors, we do not believe that inclusion of unpublished material or non-journal publications would strongly influence our conclusions regarding prognostic factors in shoulder pain.

### 4.2. Levels of evidence

Any system for defining levels of evidence is arbitrary. We chose a system that has been used in a systematic review on prognostic factors for whiplash related disorders (Scholten-Peeters et al., 2003). We believe to

Table 5
Overall level of evidence for prognostic factors and their association with (long term) poorer outcome

| Prognostic factor | Outcome | QS > 60% | QS ≤ 60% | Level of evidence |
|---|---|---|---|---|
| *Primary care* | | | | |
| Sick leave at baseline | Poor Neer-score | 1/1 (100%) | – | Weak |
| Regular medication | Poor Neer-score | 1/1 (100%) | – | Weak |
| Concomitant neck pain | Symptoms | 1/1 (100%) | – | Weak |
| High pain intensity | Symptoms | 2/2 (100%) | – | Strong |
| No precipitating trauma | Symptoms | 1/1 (100%) | – | Weak |
| No acute bursitis | Symptoms | 1/1 (100%) | – | Weak |
| Long duration of complaints | Disability, pain | 1/1 (100%) | 1/1 (100%) | Moderate |
| High disability score | Pain | 1/1 (100%) | 1/1 (100%) | Moderate |
| Previous episodes of pain | Pain | – | 1/1 (100%) | Inconclusive |
| Severe restricted passive elevation (<101°) | Disability | – | 1/1 (100%) | Inconclusive |
| *Occupational setting* | | | | |
| Middle aged | Symptoms | 2/2 (100%)* | – | Strong |
| Previous musculoskeletal disorders | Symptoms | 1/1 (100%) | – | Weak |
| High job demand | Symptoms | 1/1 (100%) | – | Weak |
| Overload at work | Symptoms | 1/1 (100%) | – | Weak |
| No sporting activities | Symptoms | 1/2 (50%) | 0/1 (0%) | Inconclusive |
| Worker group (blue vs. white color) | Sick leave | – | 1/1 (100%) | Inconclusive |
| Sick leave (preceding examination) | Sick leave | – | 1/1 (100%) | Inconclusive |
| Duration of symptoms (0–2 vs. >7 days) | Sick leave | – | 1/1 (100%) | Inconclusive |
| Continuous high intensity pain | Sick leave | – | 1/1 (100%) | Inconclusive |
| Rotation of head (pain) | Sick leave | – | 1/1 (100%) | Inconclusive |
| Abduction of arm (pain) | Sick leave | – | 1/1 (100%) | Inconclusive |
| *Secondary care* | | | | |
| Gradual onset | Poor UCLA-score | – | 1/3 (33%) on ROM | Inconclusive |
| Long duration of complaints | Poor UCLA-score | – | 1/4 (25%) on ROM | Inconclusive |
| Dominant side involved | ROM | – | 1/4 (25%) | Inconclusive |
| Type acromion (type II or III) | Poor UCLA-score | – | 1/1 (100%) | Inconclusive |
| Tenderness acromion | Poor UCLA-score | – | 1/1 (100%) | Inconclusive |
| Severe functional impairment | Poor UCLA-score | – | 1/1 (100%) | Inconclusive |
| Weakness | Poor UCLA-score | – | 1/1 (100%) | Inconclusive |
| Moderate or large tear | Poor UCLA-score | – | 1/3 (0%) | Inconclusive |
| Manual work | ROM | – | 1/1 (100%) | Inconclusive |
| Referral to specialist | Pain | – | 1/1 (100%) | Inconclusive |
| Worse baseline pain | Pain | – | 1/1 (100%) | Inconclusive |
| Worse baseline function | Function | – | 1/1/(100%) | Inconclusive |
| More education (per year) | Pain | – | 1/1 (100%) | Inconclusive |
| More education (per year) | Function | – | 1/1 (100%) | Inconclusive |
| Osteoarthritis | Pain | – | 1/1 (100%) | Inconclusive |
| Continuing overhead sports | Symptoms | – | 1/1 (100%) | Inconclusive |
| Age | Symptoms (2 studies reported age on ROM, n.s) | – | 1/6 (100%) | Inconclusive |

Only factors are presented which scored clinically relevant associations (RRs, ORs >2.0 or <0.5 or significant associations, $P < 0.05$) in at least one study. QS, quality score; UCLA, Shoulder-Rating scale of the University of California at Los Angeles; ROM, range of motion; RR, relative risk; OR, odds ratio; *in 1 study (Cassou et al., 2002) only significant for women.

have used a robust cut-off point to identify studies of high quality of methods, although any cut-off point is arbitrary. With a cut-off point of 50% (instead of 60%) there is also weak evidence for the prognostic importance of sick leave, duration of symptoms, continuous high pain intensity, rotation of head and abduction of arm in the occupational setting, and for acromion type III, tenderness acromion, severe functional impairment, weakness, moderate or large tear change in the hospital setting. In contrast, with a cut off point of 70% there is less strong evidence for the prognostic importance of middle age (45–54) in occupational setting, while there is no evidence left for overload at work.

### 4.3. Outcome assessment

As can be seen in Table 4 there is wide variation in the use of outcome measures between studies. Although most studies used a standardised assessment for at least one outcome measure, outcome measures used differed from a validated questionnaire to percentages patients reporting recovery or persistent pain. Only few studies

(Van der Windt et al., 1996; Viikari-Juntura et al., 2000) reported results for both within and after 6 months follow-up. This variation between studies makes it very difficult to pool results or to draw consistent and firm conclusions regarding the predictive value of any prognostic factor.

### 4.4. Psychosocial factors

It is suggested that there is a relationship between psychosocial factors such as depression, catastrophizing and kinesiofobia, and the persistence or recurrence of chronic musculoskeletal pain (Van der Heijden, 1999; Vlaeyen and Linton, 2000; Pincus et al., 2002). For shoulder pain the importance of these factors, and their putative mechanism are not clear. Perhaps partly the same mechanism plays a role. There is a need for sound research regarding the prognostic importance of these psychosocial factors in patients with shoulder disorders.

### 4.5. Recommendations

Systematically reviewing prognostic studies is still in development and no validated or widely used criteria list is available. But this review unmistakably shows the need for well-conducted prospective cohort studies on putative prognostic factors of shoulder disorders. Moreover, because of the few small studies on which our conclusions are based, and the high heterogeneity among studies regarding follow-up, outcome measures, and analysis, we feel that the results of this review need to be interpreted with considerable caution.

In our opinion an appropriate prospective cohort study should fulfil all the criteria of our checklist (Table 1). Such future studies should focus on the predictive value of socio-demographic and clinical factors, but in particular on psychosocial factors, notably distress, fear and avoidance, kinesiofobia, coping-styles and job demand and control for shoulder disorders. New evidence on these putative prognostic predictors will enable better decisions on the choice of interventions. Outcomes estimates preferably are to be expressed as absolute risks, instead of RRs or ORs. A multivariable prognostic analysis may help to generate a prognostic index for differentiation between patients at high and low risk of persistent shoulder complaints. Such index needs to be validated both internally, i.e. with a split sample technique in the same population and externally, i.e. tested on another population (Altman and Royston, 2000). Such an index should allow care providers easily to predict the likelihood of recovery in, for example, 6 months for any patient.

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## Appendix A. Explanation of the criteria from Table 1

A. Positive if patients were identified at an early uniform point (inception cohort) in the course of their disease (first episode, with restriction to duration of symptoms, of shoulder pain in lifetime or first treated episode of shoulder pain).

B. Positive if criteria were formulated for at least: age, duration of symptoms, relevant co-morbity (i.e cervical radiculopathy, luxation)/systemic diseases.

C. Positive if was described in what setting the patients were recruited (i.e. general practice, hospital, occupational setting).

D. Positive if the response rate was $\geq 75\%$.

E. Positive if information was presented about patient/disease characteristics of responders and non-responders or if there was no selective response.

F. Positive if a prospective design was used, also positive in case of an historical cohort in which the determinants had been measured before outcome was determined.

G. Positive if the follow-up period was at least 6 months.

H. Positive if the total number of participants was $\geq 80\%$ on the last moment of follow-up compared to the number of participants at baseline.

I. Positive if demographic/clinical information (patient/disease characteristics such as age, sex and other potential prognostic predictors) was presented for completers and those lost to follow-up/drop-outs at the main moment of outcome measurement, or no selective drop-outs/lost to follow up, or no drop-outs/lost to follow-up.

J. Positive if treatment subsequent to inclusion in cohort is fully described or standardised. Also positive in case of no treatment given.

K. Positive if standardised questionnaires or objective outcome measurements of at least 1 of the following 5 outcome measures were used for each follow-up measurement: pain, general improvement, functional status, general health status or lost days of work.

L. Positive if standardised questionnaires or objective measurements were used at baseline for at least 4 of the following 8 potential prognostic factors: age, sex, pain, functional status, duration of complaints,

neck complaints, physical workload, or dominant shoulder affected.

M. Positive if standardised questionnaires or objective measurements were used at baseline of at least 1 of the following 6 potential prognostic factors: depression, somatisation, distress, fear and avoidance, coping strategies, or psychosocial work-related factors (social support, psychological demands, and job decision latitude).

N. Positive if frequency, percentage or mean, median (Inter Quartile Range) and standard deviation/CI (confidence interval) were reported for the most important outcome measures.

O. Positive if frequency, percentage or mean, median (Inter Quartile Range) and standard deviation/CI were reported for the most important prognostic factors.

P. Positive if univariate crude estimates were provided for the association of a prognostic factor with outcome.

Q. Attempt is made to determine a set of prognostic factors with the highest prognostic value.

R. Positive if the number of cases in the multivariate analysis was at least ten times the number of independent variables in the analysis (Altman, 1991).

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